

Article

The Use of Fine Arts to Enhance Visualization and Describing Skills in a First-Year Dental Anatomy Course: A Qualitative Study

Geetha Siddanna ¹, Bradley Smith ², Andrea Mantesso ¹, Vidya Ramaswamy ³, Tracy de Peralta ⁴
and Elisabeta Karl ^{1,*}

¹ Cariology Restorative Sciences & Endodontics Department, School of Dentistry, University of Michigan, Ann Arbor, MI 48104, USA; geethads@umich.edu (G.S.); mantesso@umich.edu (A.M.)

² STAMPS School of Art & Design, University of Michigan, Ann Arbor, MI 48109, USA; brdsmith@umich.edu

³ School of Dentistry, University of Michigan, Ann Arbor, MI 48109, USA; ramaswav@umich.edu

⁴ School of Dental Medicine, University of Colorado, Aurora, CO 80045, USA; tracy.deperalta@cuanschutz.edu

* Correspondence: ekarlz@umich.edu; Tel.: +1-734-736-3352

Abstract: (1) Background: In this qualitative study, we investigated the implementation of an art-based observation workshop as a tool to improve visualization and interpretation skills in a cohort of first-year dental students (N = 109) in a dental anatomy course. (2) Methods: The art workshop was held once for a total of 60 min in the pre-clinical simulation laboratory, which is the regular teaching setting for the dental anatomy course. Visualization and interpretation skills were assessed before (pre-test) and after the art-based observation workshop (post-test). The pre- and post-tests contained five images that guided students to describe dental anatomy images. The pre- and post-test had different but similar images. Dental students accessed the pre- and post-tests on CANVAS and recorded their answers. After that, the audio recording files were analyzed and compared to determine the frequency of use of dental anatomy-specific nomenclature while answering the pre- and post-test. (3) Results: Our results demonstrate that students used dental anatomy-specific nomenclature more frequently after the intervention. (4) Conclusions: we have concluded that students' use of dental anatomy nomenclature in the first-year dental anatomy curriculum is enhanced following an art-based intervention in a regular dental simulation laboratory.

Keywords: dental anatomy; visualization skills; dental students; fine arts



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1. Introduction

Art-based interventions have been used in the medical and dental fields to improve clinical, diagnostic, and patient communication skills [1–10]. The use of fine arts in science teaching has also been proved to foster humanistic practices in education [11]. More specifically, in dental education, the use of artistic drawing exercises has been utilized as a tool to increase three-dimensional tooth drawing skills and students' engagement in the dental anatomy curriculum [12]. In the dental anatomy curriculum, it is paramount to introduce practices that encourage students to learn and apply the appropriate dental anatomy nomenclature [13,14]. Because dental anatomy courses introduce students to the appropriate nomenclature to explain and describe the morphology and spatial-functional relationships of human dentition [15,16], the knowledge students acquire in the dental anatomy course is fundamental in the subsequent phases of dental training [14,17,18].

Despite being a very important course in the dental curriculum, the traditional lecture model still adopted in dental anatomy courses presents several limitations, such as a lack of student–instructor interaction, and poor student engagement [19,20]. Furthermore, in this learning model, dental anatomy courses usually fail to prepare students to translate dental anatomy knowledge to real clinical scenarios [12,20,21]. To apply their knowledge

to real clinical scenarios, students must master the adequate application of dental anatomy nomenclature to interpret, restore, and communicate findings related to teeth more effectively [17,21]. Taken together, accuracy in visualization and application of dental anatomy terminology is fundamental in dental training.

Because art-based interventions have been previously demonstrated to increase medical and dental students' observing, describing, and interpreting complex information and communication skills [12,22,23], we proposed to test the implementation of an art-based observation workshop as a tool to increase detail visualization and interpretation skills in first-year dental students at the University of Michigan School of Dentistry (UMICH SOD). In this study, the implemented art-based observation workshop was held in the second week of the Dental Anatomy and Occlusion course, which is the first pre-clinical dentistry course in the dental curriculum at the UMICH SOD. The course is offered in the months of July and August, with a total of 4 h weekly for 8 weeks. During our art-based observation workshop, students learned to interpret fine art paintings in a variety of artistic styles from several artists including Thauvette, Klimt, and Wiley.

In this qualitative study, we hypothesized that the art observation techniques practiced during our art-based observation workshop would enhance first-year dental students' ability to visualize, interpret and describe the correct dental anatomy landmarks using specific dental anatomy terminology. To establish the appropriate dental anatomy terminology, a total of 32 dental anatomy-specific coding words describing dental anatomy features were selected, and 31 non-dental anatomy coding words were identified as non-specific descriptors of dental anatomy. We tested our hypothesis using pre- and post- art-based workshop tests. The tests quantified the use of appropriate dental anatomy terminology used by the students to describe a series of images depicting dental anatomy landmarks in the pre- and post-tests.

2. Materials and Methods

This study was reviewed and approved as a low-risk and educational research project exempted from a full review by the University of Michigan Institutional Review Board (IRB- HUM00147577). The approved methods are described below.

2.1. Study Design

Our study tested an art-based observation workshop (intervention) as a tool to increase detail visualization skills in 109 first-year dental students in a dental anatomy and occlusion course who qualified to participate in this study. The one-time art-based observation workshop was held only once. To assess visualization skills, we used a qualitative and quantitative single pre- and post-test design.

2.2. Intervention: Art-Based Observation Workshop

The art-based observation workshop introduced first-year dental students to a variety of artistic styles and paintings from artists such as Thauvette, Klimt, and Wiley. The paintings were presented and projected in the format of two-dimensional images in a series of PowerPoint slides. During the workshop, students were guided through the interpretation of the paintings using the principles of form, function, content, and context. Additionally, while using fine-art interpretation techniques, students were guided to name the observed details, and to collectively discuss and agree with the art nomenclature used to describe them. This activity was designed to encourage students to use adequate specific terms while describing the observed fine art details. The rationale for this activity was to prepare the students to describe the dental anatomy landmarks learned in the course. The art-based observation workshop was held once for a total of 60 min in the pre-clinical simulation laboratory, which is the regular teaching setting for the dental anatomy course. The art-based observation workshop was run by an artist and art faculty member at the Stamps School of Art & Design at the University of Michigan, Ann Arbor.

2.3. Subject Recruitment

The criteria to recruit and include students in this study were [24] (1) first-year dental students enrolled at the UMICH SOD in the course Dental Anatomy and Occlusion; (2) first-year dental students attending the Dental Anatomy and Occlusion course for the first time and no previous knowledge in dental anatomy; (3) first-year dental students with no academic training in fine arts; and (4) first-year dental students who were proficient in English.

2.4. Data Collection: Pre- and Post-Tests

Before the art-based observation workshop, first-year dental students were invited to take a 5-image pre-test to assess the students' ability to visualize dental anatomy images and apply appropriate dental anatomy terminology to describe them (Figure 1). All images were taken from different patients but were similar in depicting either central and lateral incisors, or dentition in maximum intercuspation as seen in Figure 1. All 5 images depicted teeth in context with adjacent teeth and soft tissues.



Figure 1. Examples of the images used in the pre- and post-tests.

Before taking the pre-test, in the first week of the course, students had been exposed only to basic dental anatomy terminology (i.e., ridges, cusps, embrasures, tooth surfaces, and names) and the alternative tooth numbering systems. The pre- and post-tests were not graded and were considered as an elective assignment in the course.

After the art-based observation workshop, students were invited to take another similar 5-image post-test to assess the students' ability to visualize dental anatomy images and apply appropriate terminology to describe the images (Figure 1). Students were given 48 h to complete the post-test after the art-based observation workshop.

Both pre- and post-tests were accessed by the students on CANVAS. To answer the pre- and post-test questions, students recorded their answers using the audio recording function on CANVAS. To answer the pre- and post-test questions, students were given the following prompts: (1) The first thing I noticed was. . ., (2) I also noticed. . ., (3) To answer the question, I. . .

2.5. Data Analysis

A third-party software (Rev.com—Austin, TX, USA) was used to transcribe the audio recording files. To transcribe the audio files, they were divided into groups of fifty that were then transcribed together to generate a Word document. At the end of the transcription phase, all Word files were compiled into two documents (pre- and post-tests). At this time, a manual correction was performed to eliminate blanks and verify missing words.

A group of five experts (1 dentist, 2 dental anatomy instructors, 1 dental education specialist, and 1 artist) defined a coding system containing words based on the dental anatomy nomenclature and art terminology used in the course and art-based observation workshop. The coding words were selected based on the most frequent words used to describe the images by the students. The coding words were organized in 2 categories as follows: (a) dental anatomy-specific words (32 words) and (b) non-dental anatomy words (31 words). The dental anatomy-specific words included the dental anatomy nomenclature.

The non-dental anatomy words included those used in the art-based observation workshop and other terms not considered as dental anatomy nomenclature.

The 32 dental anatomy-specific words were organized into the following 11 sub-categories: dental anatomy, tooth shape, tooth length, size, numbering, smile line, color (hue), position, measurement, occlusion, and judgment. The 31 non-dental anatomy coding words were divided into the following 7 sub-categories: line, shape, color, plane, texture, contrast, and measurement. Table 1 depicts the coding system with all categories, sub-categories, and coding words. These coding words were initially piloted to check for discrepancies, overlapping of categories, and to determine whether the audio recording files would be fully addressed from both dental and art practice perspectives. The coding system was then used to compile and to quantify the use and frequency of the dental anatomy-specific and non-dental anatomy words used to describe the images during the pre- and post-tests.

Table 1. Coding categories, sub-categories, and words.

Categories	Sub-Categories	Coding Words
Dental anatomy-specific words	Dental anatomy	Embrasure, incisal edge, maxilla, mandible
	Tooth shape	Rounded/sharp angle(s), canine(s), incisor(s)
	Tooth length	Long(er), short(er)
	Size	Wide(er), narrow(er)
	Numbering *	Tooth number: 8, 9, 10
	Smile line	Midline, diastema, convexity, concavity
	Color (hue)	Bright(ness), dark(ness)
	Position	Right, left, maxilla, mandible
	Measurement	Shape, size, equal
	Occlusion	Bite
	Judgment	Alignment (aligned), clean
Non-dental anatomy words	Line	Point, line, angle, boundary, edge, contour
	Shape	Negative, space, gaps, form, area, teeth
	Color	Bright(ness), dark(ness), value
	Plane	Straight, aligned, crooked
	Texture	Rough, smooth
	Contrast	Contrast, darker, brighter, opposite
	Measurement	Direction, alignment, position, distance, size

* The dental anatomy and occlusion course uses the universal numbering system.

The students' recording results (pre- and post-test recordings) were then compared with the expert group's describing words to establish the dental anatomy gold standard descriptors for each series of images in the pre- and post-test.

3. Results

A total of 109 first-year dental students (N = 109, with 53 female and 56 male students ranging from 23 to 25 years of age) were invited and attended an art-based observation workshop. Because all 109 students answered all questions in the pre- and post-test, the total number of recordings was 545 for pre-test audio recording files and 545 for post-test audio recording files.

3.1. Image 1

The first images in the pre- and post-test guided the students to describe the central incisors in relation to lateral incisors. In image 1, we found that students used the word "embrasure" (dental anatomy-specific) 147 times in the pre-test compared to 178 times in the post-test. Furthermore, students correctly applied the word "maxilla" 6 times in the pre-test as compared to 12 times in the post-test. When we compared the use of the non-dental anatomy words in the pre- and post-test, we observed that the non-dental anatomy words were used more in the pre-test. For example, the word "spot(s)", which was used as a

non-dental anatomy word to describe the maxillary position, was used 322 times in the pre-test compared to 248 times in the post-test. The use of the word “length”, which is also categorized as a non-dental anatomy word, decreased in the post-test compared to pre-test. Inversely, the use of the universal tooth numbering system (dental anatomy-specific) increased in the post-test compared to the pre-test. In summary, in image 1 of both tests, we observed an increase in the use of dental anatomy nomenclature (dental anatomy-specific words) in the post-test compared to the pre-test.

3.2. Images 2 and 3

The second and third images used in the pre- and post-tests aimed to encourage students to compare the incisal edges, embrasures, and mamelons. For images 2, the students’ responses containing the word “embrasure” (dental anatomy-specific word) went up to 13 times in the post-test compared to 8 times in the pre-test. The word “spot”, as a non-dental anatomy word used to describe the position of the incisal edge, was used 213 times in the pre-test compared to 177 times in the post-test. When we analyzed the words to describe the width and size of the teeth depicted in image 2 of the tests, we found no difference between the pre- and post-test responses. For image 3, the responses showed again an increase in the use of the dental anatomy-specific word “embrasure” from 137 in the pre-test to 181 in the post-test. More specifically, there was an increase in the use of the dental anatomy-specific word “canine(s)”, which was used 29 times in the pre-test compared to 48 times in the post-test. Interestingly, in image 3, we found a decrease in the use of the dental anatomy-specific word “size” from 24 in the pre-test to 18 in the post-test. In summary, as observed in the image 1 and 2 results, the use of dental anatomy-specific words increased for image 3 in the post-test.

3.3. Images 4 and 5

The fourth and fifth images in the pre- and post-tests were used to encourage students to describe and compare the incisal edges and incisal angles of the central incisors depicted in those images. In image 4, students used the dental anatomy-specific word “incisors” 55 times in the post-test as compared to 33 times in the pre-test. The dental anatomy-specific words of “incisal edge” were used 5 times in the pre-test compared to 18 times in the post-test. For image 5, the number of respondents using the terminology “rounded angles” (dental anatomy-specific) to compare the mesial and distal incisal angles increased significantly from 2 in the pre-test to 23 in the post-test. Interestingly, in image 5 of the pre- and post-tests, the number of respondents using the tooth numbering system to describe the teeth depicted in the images decreased from 51 times in the pre-test to 49 times in the post-test. However, a total of 27 responses in the post-test used the dental anatomy-specific word “maxilla” and/or “mandible” to describe the images as compared to only 4 responses in the pre-test.

A summary of the students’ dental anatomy-specific words that had their use increased in the post-test to describe the given images can be seen in Table 2.

Table 2. Students’ use of dental anatomy-specific words increased in the pre- and post-test.

Dental Anatomy-Specific Word	Pre-Test	Post-Test
Embrasure (image 1)	147	178
Maxilla (image 1)	6	12
Embrasures (image 2)	8	13
Embrasures (image 3)	137	181
Canines (image 3)	29	48
Incisors (image 4)	33	55
Incisal Edge (s) (image 4)	5	18
Rounded Angle (s) (image 5)	2	23
Maxilla and/or Mandible (image 5)	4	27

4. Discussion

In this study, first-year dental students were invited to attend an art-based observation workshop as part of the Dental Anatomy and Occlusion course. Our hypothesis was that the art-based observation workshop would enhance visualization and interpretation skills measured by the proper dental anatomy terminology used by students to describe a series of images [25]. Because all students were first-year dental students in their first pre-clinical dentistry course, the overall students' choices of words were basic dental anatomy descriptors. Additionally, because the art-based observation workshop was held in the second of week of the course, it is possible that the art terms used in the art-based observation workshop such as "contrast" and "lines" may have facilitated the students' visualization of some dental anatomy landmarks such as "embrasures", "edges", and "angles" more often than others (Table 1). Therefore, although we observed an overall increase in the use of dental anatomy-specific words as descriptors in all post-test images, we also observed that some words were used less often or even had their use decreased in the post-test.

For example, in images 1 and 5, we observed that while some dental anatomy-specific words such as "embrasure" and "maxilla" were more used in the post-test, a few words such as "midline" and "prominences", which are also dental anatomy-specific, decreased in the post-test compared to the pre-test. It is possible that our implemented art-based observation workshop used examples of fine art paintings that were interpreted in a manner that guided the students to see details that are more related to some dental anatomy features (i.e., embrasures, maxilla) than others (i.e., midline, mesio-distal).

We implemented a one-hour, one-session, art-based observation workshop that was held in the regular dental anatomy teaching setting. During the art-based observation workshop, an artist/art faculty member guided students in the observation and interpretation of several art media images using the art interpretation principles of form, function, content, and context. As seen in previous studies with medical students, the art-based observation workshop was followed by enhanced dental student performance in their overall ability to use dental anatomy-specific words when describing dental anatomy related images [26,27]. One possible explanation for this finding is that, during the workshop, students were guided to see the details and encouraged to name them and collectively agree with the used terms. Therefore, as seen previously, the implemented art-based observation workshop may have facilitated a deeper understanding of some dental anatomy concepts and, consequently, the student's accuracy of identifying and describing some anatomical landmarks [28].

Although in this study we did not focus on the students' perceived experience with the art-based observation workshop, students voluntarily agreed to take the pre- and post-tests and to participate in the workshop. Therefore, it is possible that students were engaged in this art-based teaching activity considering the high number of the participants in this project [28,29].

While many authors have investigated the use of art-based interventions in museums and other non-clinical classroom settings [6,30], in this study we observed that art-based sessions in the dental curriculum can be held in normal dental teaching settings, such as our simulation laboratory. The fact that we could implement an art-based activity in the regular dental anatomy teaching settings is logistically positive, because it overcame the hurdles of taking a large cohort of students to a site removed from the customary clinical setting. Importantly, holding the art-based observation workshop in the simulation laboratory made this project affordable and reproducible.

We used CANVAS to record the students' descriptions of the images following the prompts the authors selected to guide the students, considering the students were first-year dental students with very little knowledge in dental anatomy. The prompts may have influenced the students to use some words more often than others. Nonetheless, because the prompts were the same for the pre- and post-test, we strongly believe that the art-

based observation workshop facilitated the students' use of some dental anatomy-specific nomenclature while describing the pre- and post-test images.

There are two important limitations in this study. We did not have a control group to accurately assess the results of the art-based observation workshop. Because our dental students continued the dental anatomy and occlusion learning and training activities as planned for the course, it is possible that these regular course activities could have affected the post-test results as much as or more than the art-based workshop, even considering that students were given only 48 h to answer the post-test after the art-based observation workshop. Furthermore, because the dental anatomy course at the UMICH SOD only lasts for 8 weeks, there was no available session to split the classroom or use other dental education assessment methods such as the flipped classroom [31]. The second limitation was related to the fact that students had to record their answers on CANVAS and the recording files had some missing words. Although we performed a careful review of the files and transcriptions, it is possible that a few words were not transcribed accurately, which could have changed the results presented in this study.

5. Conclusions

Despite the limitations in this qualitative study, we have concluded that art-based observation workshops may increase the first-year dental students' accurate use of the dental anatomy nomenclature in a dental anatomy and occlusion course. Future research is needed to specifically determine the role of art-based intervention in increasing dental students' visualization skills and performance in the dental curriculum.

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Informed Consent Statement: Participants consent was waived due to the low-risk and classroom educational activities involved in this study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to the educational nature of this study.

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